DREDGED MATERIAL RESEARCH PROGRAM

TECHNICAL REPORT D-78-30

FIELD INVESTIGATIONS OF THE NATURE DEGREE, AND EXTENT OF TURBIDITY GENERATED BY OPEN-WATER PIPELINE DISPOSAL OPERATIONS

by

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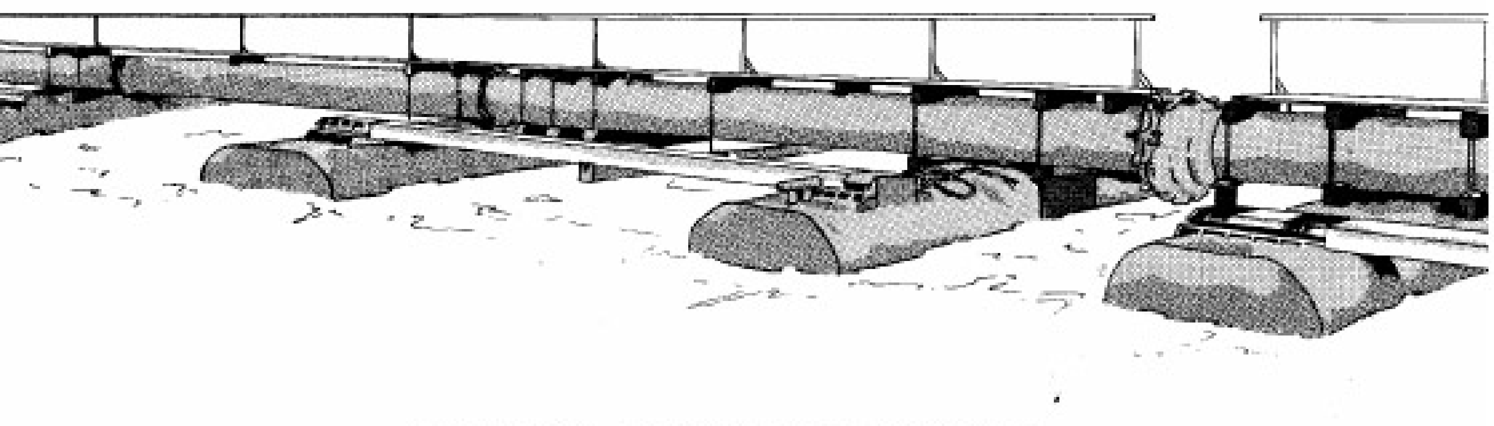

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SUBJECT: Transmittal of Technical Report D-78-30

TO: All Report Recipients

1. The technical report transmitted herewith represents the results of one research effort (Work Unit 6C02) initiated as part of Task 6C, entitled "Turbidity Prediction and Control," of the Corps of Engineers' Dredged Material Research Program (DMRP). Task 6C, included as part of the Disposal Operations Project of the DMRP, was concerned with investigating the problem of turbidity and developing methods to predict the nature, extent, and duration of turbidity generated by dredging and disposal operations. Equal emphasis was also placed on evaluating both chemical and physical methods for controlling turbidity generation around dredging and disposal operations.

2. Although there are still questions about the direct and indirect effects of different levels of turbidity on various aquatic organisms, turbidity generated by dredging and disposal operations can be aesthetically displeasing. Therefore, regardless of the ecological effects associated with turbidity, it may be necessary under certain circumstances to be able to predict levels of turbidity that might be generated by a particular dredging or disposal operation. These predictions can then be used to evaluate the necessity for different control measures.

3. This particular study was concerned with turbidity generated in the upper water column by open-water pipeline disposal operations. Based on plume characteristics measured at three estuarine sites along the Gulf Coast, a theoretical/empirical mathematical model was developed to predict suspended solids concentrations in and dimensions of a turbidity plume that might be generated by a typical open-water pipeline disposal operation. In addition to studying the dredged material suspended in the upper water column downcurrent of the operation, dissolved nutrients and heavy metals were also measured to determine the degree of release of these chemical constituents. Methodologies for predicting heavy metals/nutrient distributions and dissolved oxygen levels in the vicinity of a pipeline disposal operation were also developed as part of this research effort. This report is concerned only with the dredged material suspended in the upper water column and does not address the dispersion of the majority of the dredged material that forms a fluid mud layer over the bottom of the disposal area.

4. This study represents one of a series of reports on turbidity prediction and control. Other studies within Task 6C provide information on silt curtains, submerged pipeline discharge, and the generation of fluid mud dredged material. All research results from Task 6C are synthesized in a technical report entitled "Prediction and Control of Dredged Material Dispersion Around Dredging and Open-Water Pipeline Disposal Operations."

JOHN L. CANNON
Colonel, Corps of Engineers
Commander and Director

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Appendices B, C, and D were reproduced on microfiche and are enclosed in an envelope attached inside the back cover of this report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

In response to the public's concern over the environmental effects of open-water disposal of dredged material, this study was undertaken to evaluate the characteristics of turbidity plumes in the vicinity of open-water pipeline disposal operations. In addition, the distribution and concentration of dissolved heavy metals, nutrients, and dissolved oxygen were evaluated. Based on field studies conducted in Corpus Christi Bay, Texas, Atchafalaya Bay, Louisiana,

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20. ABSTRACT (Continued).

and Apalachicola Bay, Florida, a simple model was developed to predict the spatial and temporal distributions of suspended solids in turbidity plumes.

Turbidity plume characteristics are primarily dependent on the discharge rate of the dredge, the settling velocity of the suspended dredged material, the water depth, the hydrodynamic regime (i.e., current velocity and diffusion velocity) of the disposal site, and the age of the plume. Several estimates of dredged material partitioning between the turbidity plume and the bottom layers indicate that 97 to 99 percent of the discharged slurry rapidly settles to the bottom of the disposal area within a few tens of meters of the discharge point. The remaining 1 to 3 percent is incorporated into the plume.

No well-defined plumes of dissolved metals were observed at any of the three sites, indicating that dissolution of metals from the suspended solids was limited. Increases in concentrations of suspended solids and particle-associated metals in the receiving waters were obviously associated with the discharge plume. Concentrations of dissolved ammonia and silica were locally increased near the discharge; however, no increases in dissolved phosphate were noted, despite high dissolved phosphate concentrations in interstitial water of the channel sediment being dredged.

Elutriate test results using the channel sediment were found to have limited use in predicting changes in concentrations of dissolved metals during open-water disposal operations.

A simple model was developed to predict concentrations of particle-associated constituents.

Although large quantities of reduced sediment with a high oxygen demand are introduced into the water column during open-water pipeline disposal operations, only a small fraction of this material is reactive on a time scale comparable to that associated with the settling of the vast majority of the dredged material slurry. Dissolved oxygen levels in surface waters in the immediate vicinity of the pipeline discharge point are depressed by 1 to 2 mg/l with dissolved oxygen levels decreasing with depth due to increasing levels of suspended solids. Dissolved oxygen levels tend to increase with distance away from the discharge point primarily due to dilution within the mixing zone at the disposal site.

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